

location in a surgical suite outside of the sterile field. This may be on the wall or on a hospital cart that is not in use. In the illustrated embodiment, as the computer 10 is inserted into the cart, a series of electrical interconnections are made, including interconnection with a display e.g., a flat screen monitor 14, interconnection with an electrical wall outlet, backup power supply unit contained within the cart, or some combination thereof, interconnection with one or several tracking system cameras 16, and the like. The tracking system cameras 16 for tracking the location of markers including but not limited to acoustic sensors, infrared sensors, and the like, are mounted on mobile carts, suspended from the ceiling of the surgical suite, mounted in conjunction with other equipment in the surgical suite such as the lighting, the operating table, or the like. In one embodiment, the cart 12 includes a port for connecting the computer 10 with the central record storage system of the hospital via a network, a diagnostic imaging device 64, or other source of electronic images of the patient. In other embodiments, the computer 10 includes a disk, tape, or other media drive for receiving the image information via a portable medium.

With reference to FIGURE 2, for each surgical application, there is a corresponding software-integrated disposable kit 20. The kit 20 includes a sealed, e.g., shrink-wrapped, carry-case or unit 22 which contains all of the necessary equipment for performing a specific surgical procedure indicated on a label 24 on the outside of the kit. A variety of kits 20 are provided, each labeled for a specific surgical procedure or limited group of closely related surgical procedures. Each kit 20 typically includes the appropriate surgical tools for the corresponding procedure, such as instrumented drill guides 26, 28, instrumented probes 30, and other accessories as may be appropriate to the selected procedure. The tools are instrumented with markers 32 which are tracked by the

cameras 16, in the preferred embodiment. Additional markers 32 not attached to a tool may be included in the kit 20. In other embodiments, the markers 32 are acoustic or infrared transmitters whose signals are received by  
5 corresponding acoustic or infrared cameras 16. By tracking the markers 32 with one or several cameras 16, the current location of each marker 32, hence the associated tool, is readily determined by well-known triangulation techniques. In other embodiments, more than  
10 two cameras 16 or other sensors are provided for improved tracking even when the surgeon temporarily blocks access to one of the markers 32. Each of the drill guides 26, 28, probes 30, and other surgical tools and accessories are presterilized and wrapped in peel-open or other  
15 sterile packaging.

The kit 20 further includes several other components which are commonly used during image guided surgery. These components can include a universal tool tracker 34 which is mounted directly to a fixed location  
20 on the tool. The universal tool tracker 34 is used to track standard surgical tools that are not included as part of the kit 20. A registration phantom 36 that is attached to the operating room table or directly to the imaging device is also included and is used to register an  
25 acquired image(s) to the patient's anatomy. Depending on the surgical procedure, other components may be included such as a head frame 38 with markers for attachment to the patient. All the components contained in the kit 20 are again presterilized and prepackaged in sterile packaging.

30 The kit 20 further includes, but is not limited to, a user input device(s) 40 such as a joystick, mouse or keyboard with which the operator controls the software's graphic user interface. The user input device(s) 40 and their associated cable(s) are sterile and packaged in  
35 sterile packaging. During set-up for the procedure, the sterile packaging is opened and the cable(s) for the user input device(s) 40 is plugged into a corresponding port on

the computer 10 or mobile cart 12. Another embodiment includes a wireless user input device(s) that is recognized by the system, through an infrared port for example on the computer 10 or mobile cart 12.

5           The kit 20 can further include implants 42 and other surgical accessories that are used in the selected surgical procedure. For example, the kit 20 can include pedicle screws 42, rods 44, and mounting clamps 46, and the like as are appropriate for a surgical procedure on  
10 the spine. Different surgical procedures will, of course, have different surgical accessories in the kit 20. The surgical accessories are sterile and sealed in sterile packaging.

          The kit 20 further includes a one-time-use  
15 digital medium 50, such as a small high-capacity diskette, CD-ROM, DVD, or the like. The digital medium 50 is configured to be received into a drive 52 in the computer 10. The diskette 50 contains a portion of the software to be used during a surgical procedure, image processing  
20 algorithms specific to the application, dimensions and other specifications of the surgical tools and accessories in the kit 20, and other information of use during the surgical procedure.

          With reference to FIGURE 3, the computer 10 may  
25 include triangulation or tracking software and base or low-level graphics and other processing software 60. A video-grabber card or other similar input/output device for capturing still-images or live video includes an input/output port and/or interface 62 for receiving  
30 electronic images directly from an imaging device 64. Images can also be received through the computer network port by accessing central record keeping via the hospital's network. Optionally, the computer 10 may include a drive for reading the electronic image  
35 information obtained from the imaging device 64 from disk, tape, or other similar media. The computer 10 also includes a graphics card or the like with a port and/or